Space Weather Technical Forecast

Issued on Thursday 14 November 2024 at 01:11 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: R1/R2 likely throughout. Slight chance of G1/Minor Geomagnetic Storm intervals, mainly Days 1 and 4 (14 and 17 Nov).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate during the past 24 hours with two M-flares, the largest an M1.7 peaking at 13/1708 UTC from AR3889.

There are now five sunspot regions on the visible disc, with AR3883 having rotated around the western limb. AR3889, just west of south-centre disc, is the largest and most complex region. It consists of two main clusters of mature spots with a couple of small delta regions in the lead and intermediate areas. The remaining regions are relatively small and simple.

No CMEs observed over the past 24 hours are considered to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: Solar winds at L1 measured by ACE were indicative of a slow regime. The wind speed varied between 320-370 km/s. Density was below average. The interplanetary magnetic field (IMF), Bt, was weak for much of the period, becoming moderate between 13/1030-1500 UTC with a peak of 9nT. The north-south component, Bz, mostly varied weakly, except between 13/1100-1215 UTC when it became moderately southward directed. The phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet (Kp0-2) throughout.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was initially at mostly moderate levels, peaking at 617pfu at 13/1630 UTC. The associated 24-hour fluence has been on a slight upward trend, but remains below the Active threshold. The integrated flux observed at 14/0000 UTC was 1.79e7.

Four-Day Space Weather Forecast Summary

Solar Activity: Isolated M-class flares are likely throughout the period, with a slight chance of X-class flares, mostly from AR3889.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Connection to a coronal hole fast wind is possible during Day 1 (14 Nov) with slightly elevated wind speeds which could then persist for much of the period. Geomagnetic activity is expected to be largely Quiet to Unsettled (Kp0-3). On Day 1 (14 Nov), Unsettled to Active (Kp3-4) conditions are possible with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp5). During Days 2-3 there remains a very slight chance of further G1/Minor Geomagnetic Storm intervals. This risk then rising again on Day 4 (17 Nov) with a possible connection to another coronal hole fast wind.

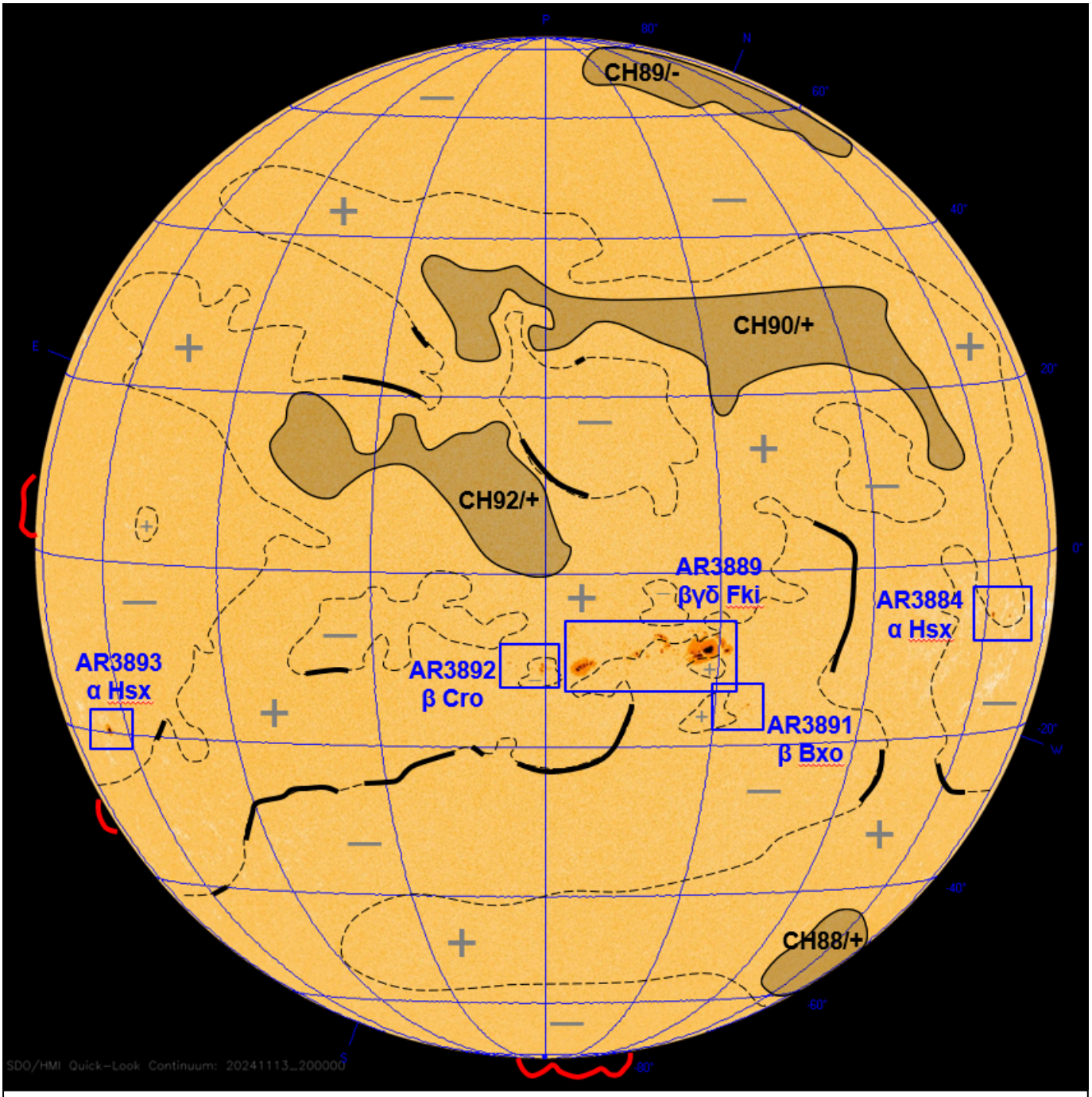
Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is at background levels. There is a slight chance of S1/Minor solar radiation storms, mainly due to the potential for flaring from AR3889 as it rotates into a more geoeffective position in the western hemisphere.

The high energy electron flux may potentially rise to diurnal peaks at high levels during the period, with the associated fluence most likely persisting below Active levels but with a rising trend.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1: Solar Synoptic Map valid 13/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms

No Earth-directed CMEs currently feature in the forecast. One filament lift-off from the southern hemisphere on 11 Nov produced a CME around 11/1630 UTC which is expected to pass below Earth's orbit. However, a small number of Enlil ensemble members suggest some glancing enhancement on Day 1 (14 Nov) attributed to this event. There are a number of filaments which have shown signs of instability and warrant monitoring for potential sources of CMEs during the period.

The four-day forecast comprises primarily of coronal hole influences. Connection to a HSS from CH90/+ is possible during Day 1 (14 Nov) with some element of enhancement persisting through much of the forecast period, however it may be the case that the Earth only brushes along the southern boundary of this coronal hole, with enhancements coming and going. This was perhaps in evidence during 13 Nov, with a brief increase in magnetic field and wind speeds observed before a return to nominal conditions. This feature gave only limited influence on the previous rotation, with solar winds reaching around 450-500km/s, but does extend further east and slightly further south currently. MOSWOC Enlil is not suggesting a significant connection to CH90/+, so confidence is low. Connection to a HSS from CH92/+ is possible on Day 4 (17 Nov), with CH92/+ currently located just east of centre disc.

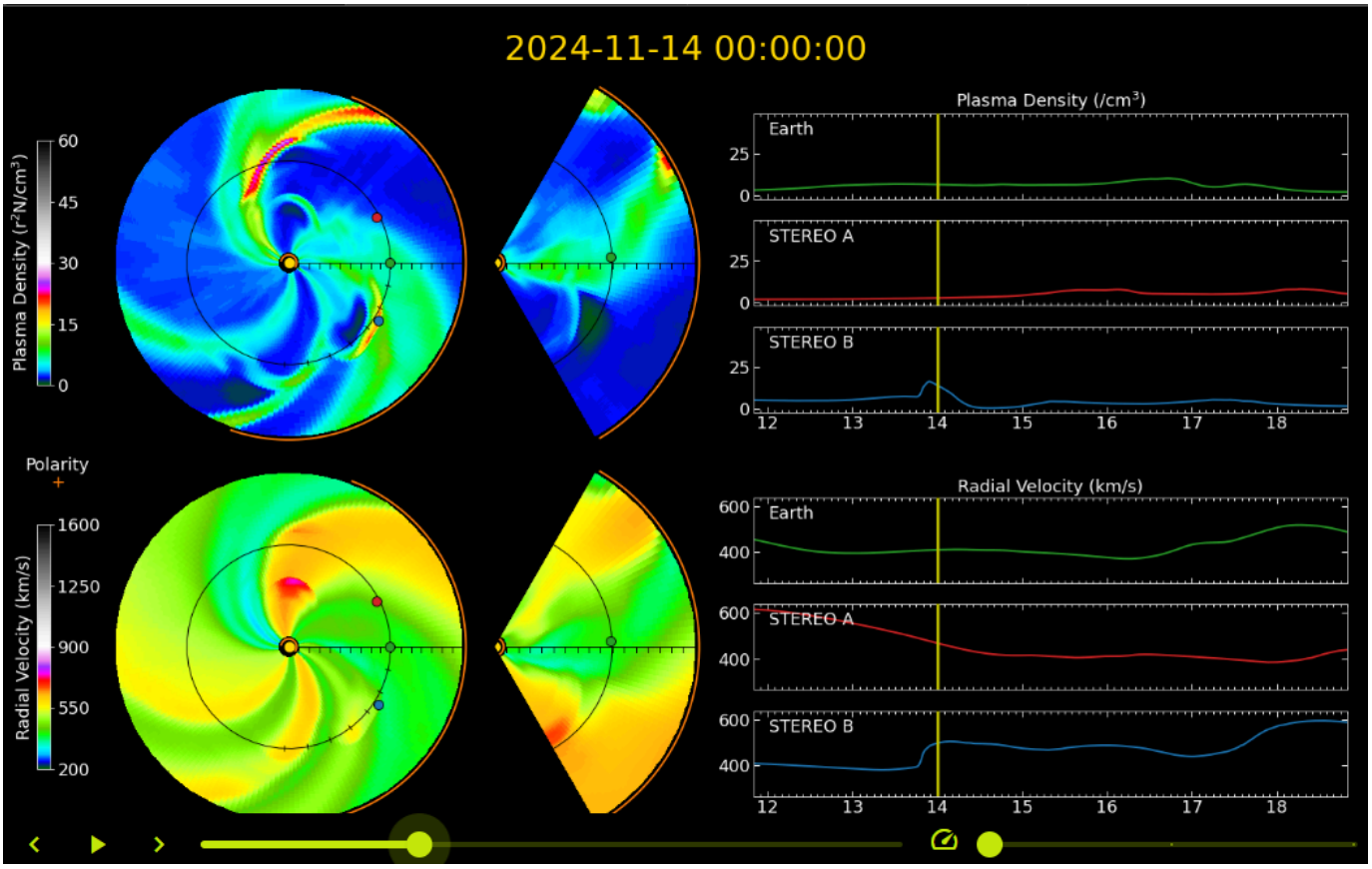
Geomagnetic activity is expected to be largely Quiet to Unsettled (Kp0-3) through the period. On Day 1 (14 Nov), Unsettled to Active (Kp3-4) conditions are possible with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp5) following any connection to the HSS from CH90/+. During Days 2-3 there remains a very slight chance of further G1/Minor Geomagnetic Storm intervals owing to the feature's longitudinal extent. This risk then rising again on Day 4 (17 Nov) with a possible connection to another HSS from CH92/+.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

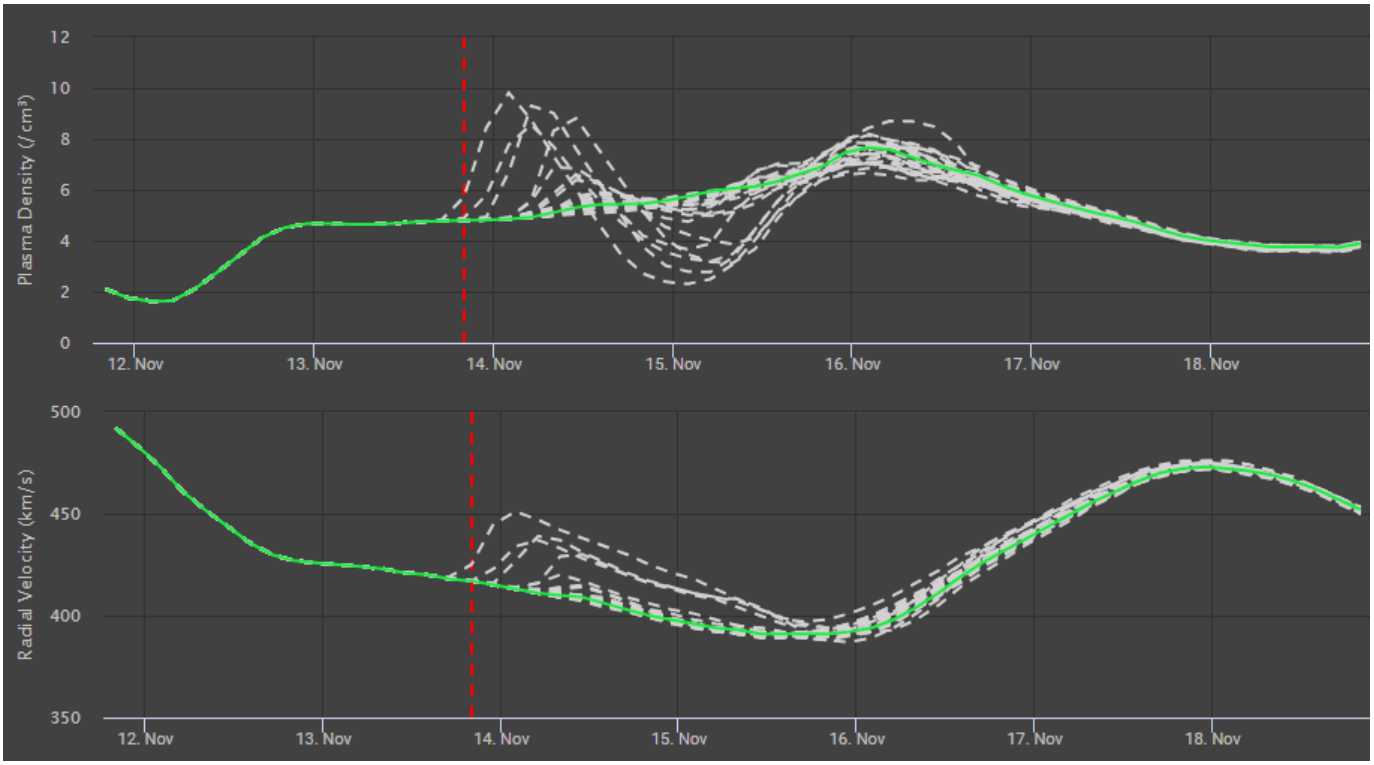
© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOC Enlil model. Note Enlil is not suggesting any connection to CH90/+.



© Crown Copyright 2024. All Rights Reserved.

Figure 3: MOSWOC Ensemble model. Note a few members indicate a possible glance from the filament liftoff CME on 11 Nov.



© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares

Solar activity was Moderate during the past 24 hours with two M-flares, the largest an M1.7 flare peaking at 13/1708 UTC from AR3889.

There are now five sunspot regions on the visible disc, with AR3883 having rotated around the western limb. AR3889, just west of south-centre disc, is the largest and most complex region. It consists of two main clusters of mature spots with a couple of small delta regions in the lead and intermediate areas. AR3884, in the southwest, now looks to be a unipolar group. AR3892, trailing AR3889, has continued to show signs of decay. The remaining regions are relatively small and simple.

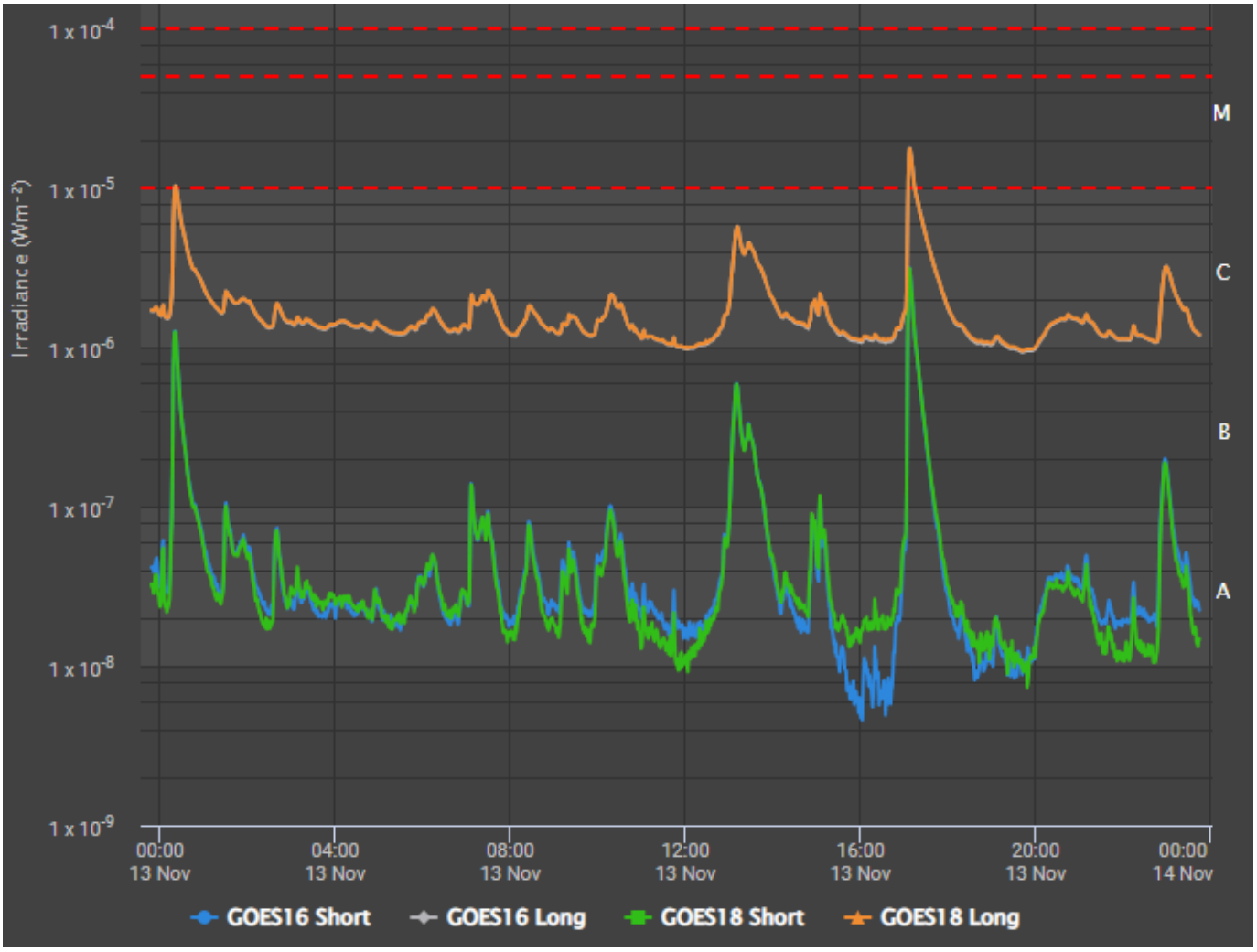
Moderate activity is likely, with a slight chance of X-flares, most likely from AR3889.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 4: GOES-16 & -18 X-ray flux.



© Crown Copyright 2024. All Rights Reserved.

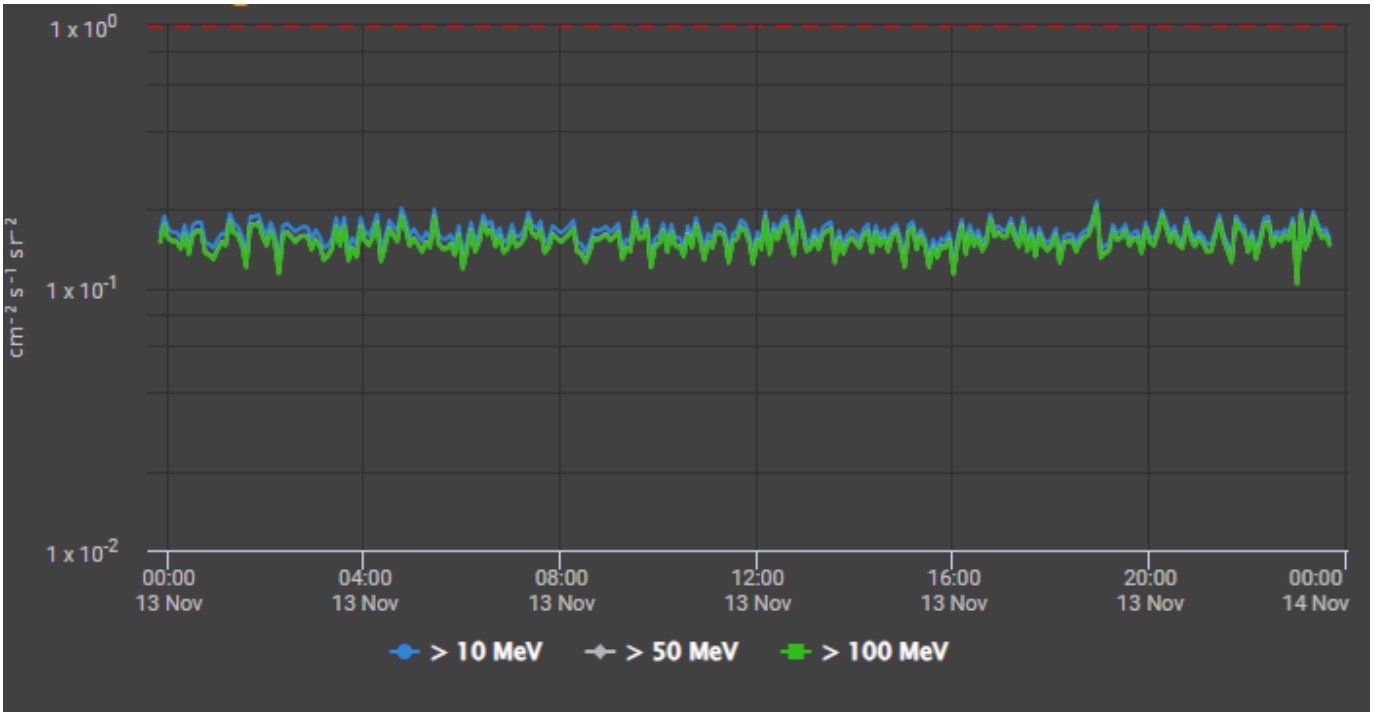
Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is at background levels and is likely to remain that way during the period in the absence of any significant flare activity.

There is a slight chance of S1/Minor Solar Radiation storms over the period, mainly due to any potential flaring from AR3889 as it rotates into a more geoeffective position in the western hemisphere. There is a smaller risk from AR3883, which declines later in the period as this region rotates well away from the west limb, but this is largely balanced by AR3889 rotating westwards.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: GOES-18 Proton flux.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons (≥ 2MeV)

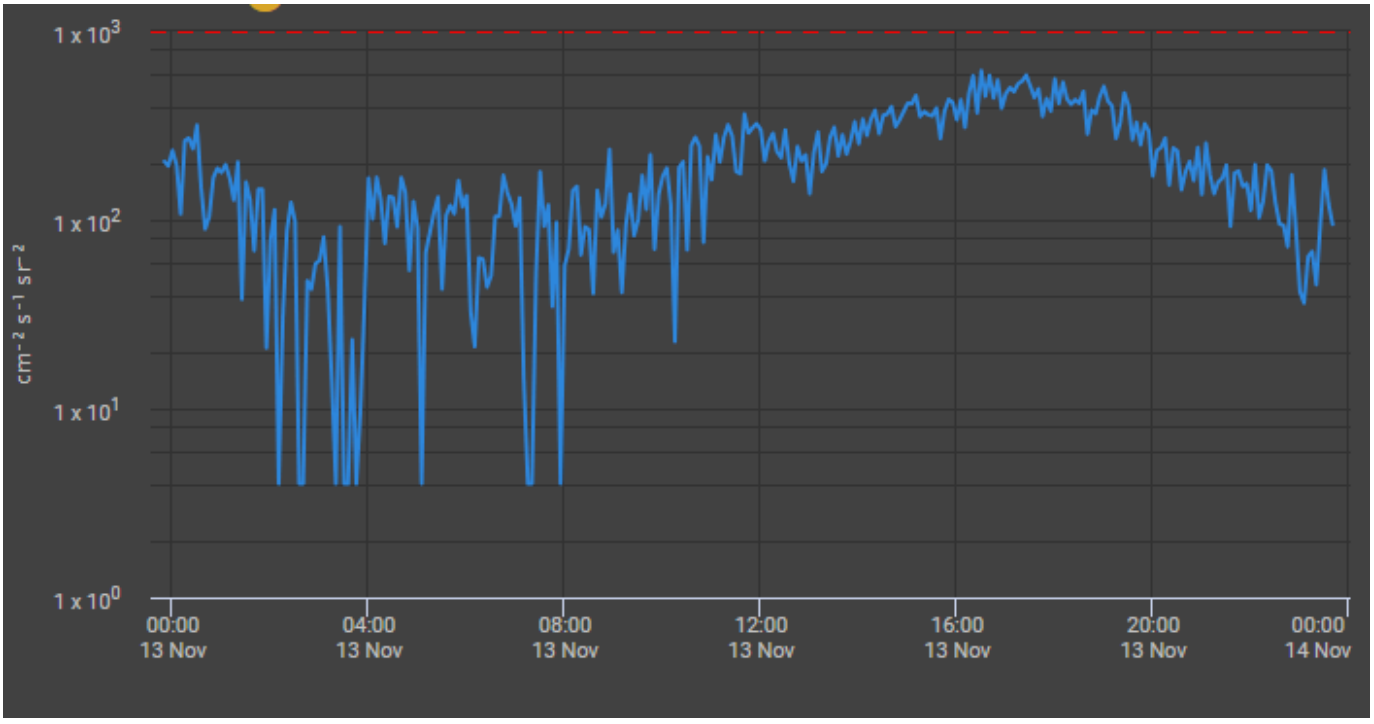
High energy electron flux (greater than 2MeV) as observed by GOES16 is at mostly moderate levels.

Persistence-wise, Earth is now approaching a period where spells of high flux are likely, with diurnal maxima reaching high levels during the last rotation of what is now CH90/+. 24-hour fluence levels are expected to remain below Active levels, although with MOSWOC REFM perhaps a little low in its forecast fluence level.

Overall, in the absence of any CME arrivals, there is a rising slight chance of Active fluence, peaking later in the period after geomagnetic activity subsides from the onset of CH90.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	5	10	15	15
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

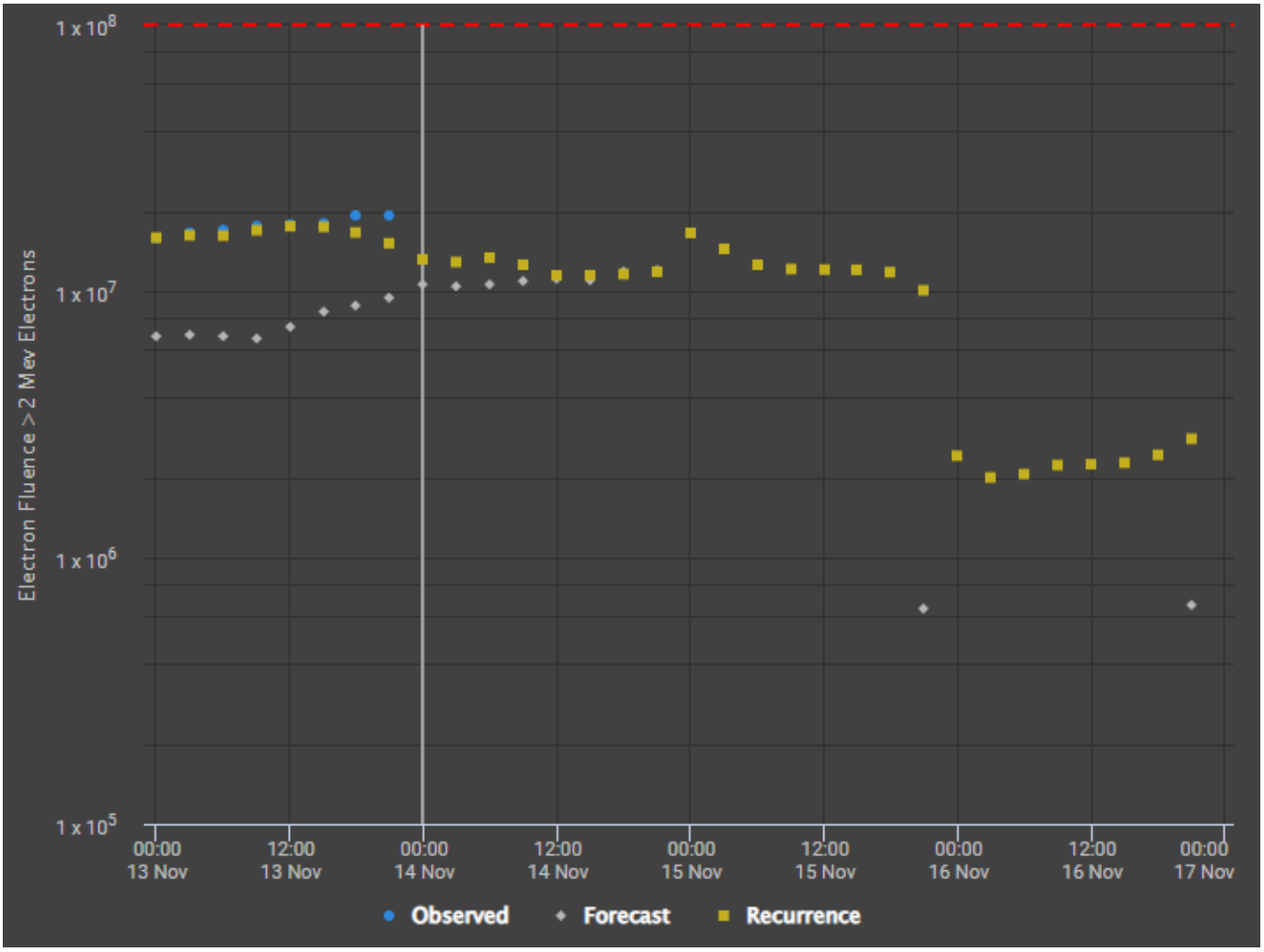
Figure 6: GOES-16 Electron flux.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 7: MOSWOC REFM, providing reasonable guidance.



© Crown Copyright 2024. All Rights Reserved.